NISTTech

Ultrasonic Strain Gage Using a Motorized Electromagnetic Acoustic Transducer

Rapid collection and analysis of real time data for calculating stress in a specimen using electromagnetic acoustic transducers (EMAT)

Description

Real time, repeated, non-destructive measurement of strain in metallic objects is obtained by using a novel arrangement of rotating electromagnetic acoustic transducers (EMAT) as gages. An EMAT is connected to a processor to make a strain gage that can be rotated through 360 degrees to calculate the stress in a specimen. The EMAT rotates about a central axis while collecting data on a specimen. The invention is used to measure the change in plane stress in metallic components (e.g. rolled plates of steel and aluminum) and in shrink-fit specimens.

Note: See U.S. Divisional patent # 6,502,463 under Citations below.

Applications

- **Manufacturing**
  Repeated non-destructive stress calculations in rolled aluminum and steel.

Advantages

- **Non-destructive, real time sampling**
  Real time, repeated measurement of stress in metallic specimens under production.
- **Ease of use**
  Less time needed to manually orient and reorient sensor equipment.

Abstract

A method and apparatus for measurement of stress in a specimen utilizing a motorized electromagnetic acoustic transducer (EMAT). Stress causes a rotation of the pure-mode polarization directions of SH-waves and a change in the phase of waves polarized along these certain directions. The method utilizes a rotating small-aperture EMAT, connected to a processor, to measure phase and amplitude data as a function of angle. The EMAT is placed on a workpiece at the location where the stress is to be measured. The acoustic birefringence B is determined from the normalized difference of these phases. From these data, an algorithm calculates values of B and φ. The workpiece is then stressed or its stress state is changed. The values are measured again at the same location. Stress is determined from the change in B and φ.

Inventors

- Alers, George A.
- Clark, Alfred V.
- Coakley, Kevin J.
- Hehman, C. S.
- Nguyen, Thanh N.

Citations

1. U.S. Divisional Patent # 6,502,463

References

- Expired U.S. Patent # 6,311,558 issued 11-06-2001
- Docket: 98-020US

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

Last Modified: 07/26/2011